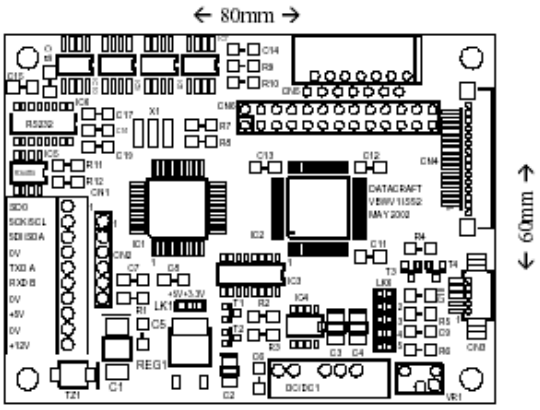
Specification

VBWV1 is a display driver board aimed at enabling design engineers to evaluate LCDs (small to medium monochrome and colour displays) using a low cost serial interface.



Depth 14mm Max

VBWV1 Features

- Epson display controller with 80K byte of embedded SRAM
- Drives active matrix TFT/TFD and passive single and dual scan displays. Up to 640 x 480 resolution.
- 1/2/4/8 bit per pixel (bpp) colour depth support
  640x480 at 2 bpp
  640x240 at 4 bpp
  320x240 at 8 bpp
- Up to 16 shades of grey on monochrome panels
- Hardware portrait mode enabling direct hardware 90-degree rotation of display image.

Continued……

Continued ……

- 3.3V and 5V panel support
- RS232 (optional RS485, I^2C, and SPI) interface
- LCD VEE voltage generation on board, with contrast adjustment
- Up to 128K byte of E2prom on board, for picture storage (32K standard)
- Character set built in to micro-controller flash memory
- Character size 8x8 and 8x16 available
- Foreground and background character colour attributes
- Direct write and character write modes
- Block transfer of graphics data from E^2 memory to display memory
- Storage of Display controller set-up registers register and look up table in micro-controller internal E^2 memory enabling automatic display initialisation on power up
- On board Flash based in circuit programmable micro-controller for easy updates and customisation (Interface directly to MPLAB ICD via CN2)

Interconnection details

CN1 Interface and power connection Molex 22-05-1102	
PIN	**Signal**
1	SDO
2	SCK/SCL (I2C)
3	SDI/SDA (I2C)
4	0V
5	TXD (RS232/RS485A)
6	RXD (RS232/RS485B)
7	0V
8	+5V In
9	0V
10	+12V/+5V In (for backlight inverter)

Continued……

Continued……

CN2 Programming interface for firmware updates 0.1" Header	
PIN	**Signal**
1	PGM
2	PGC
3	PGD
4	0V
5	+5V
6	VPP

CN3 Backlight inverter interface Molex 53261-0590	
PIN	**Signal**
1	+12V/+5V Safe (switched via LCDPWR pin) Origin = CN1 pin 10
2	0V
3	+5V Safe (switched via LCDPWR pin)
4	Dim use R4 to set backlight brightness
5	Dim use R4 to set backlight brightness

CN4 Colour STN display interface 1mm pitch FFC	
PIN	**Signal**
1	FPFRAME
2	FPLINE CL1
3	FPSHIFT CL2
4	LCDPWR
5	+5V/3.3V
6	0V
7	VEECON
8	FPD0
9	FPD1
10	FPD2
11	FPD3
12	FPD4
13	FPD5
14	FPD6
15	FPD7
16	0V

Continued……

Continued……

CN5 Monochrome display interface 1mm pitch FFC	
PIN	**Signal**
1	FPD4
2	FPD5
3	FPD6
4	FPD7
5	LCDPWR
6	FPFRAME
7	NC
8	FPLINE
9	FPSHIFT
10	+5V/3.3V
11	0V
12	VEE-
13	VEECON
14	0V

CN6 General purpose display connection 26 way IDC			
PIN	**Signal**	**PIN**	**Signal**
1	VEE+	2	VEE-
3	VEECON	4	+12V Safe
5	+5V/3.3V	6	+5V/3.3V
7	0V	8	FPSHIFT
9	0V	10	LCDPWR
11	DRDY	12	FPFRAME
13	FPLINE	14	FPD0
15	FPD1	16	FPD2
17	FPD3	18	FPD4
19	FPD5	20	FPD6
21	FPD7	22	FPD8
23	FPD9	24	FPD10
25	FPD11	26	GPIO

Continued……

Continued…….

Link Details

LK1 Solder Link	
PIN	**Signal**
1 & 2	+5V display
2 & 3	3.3V display

LK1 sets the operating voltage to either 5V or 3.3V. Note this also affects the SPI and I2C

LK2-6 Solder Link **one only**	
PIN	**Signal**
2	For +VEE 35V
3	For +VEE 42V
4	For +VEE 30V
5	For –VEE -30V
6	For +VEE 5V

LK2-6 sets the LCD VEE voltage level. These affect the VEE+ VEE- and VEECON levels as shown in the table. Note : link only one if the DC/DC converter is fitted. For displays with a contrast voltage between 0V and 5V, remove the DC/DC converter, and link 6 and 4. VR1will then control the VEECON voltage between 0 and 5V. Increasing R6 and R5 can further restrict the swing

Command summary

Stx=02h Etx=03h Data=00h to ffh Ack=06h Nak=15h Dc4=14h Null=00h

Command	Hex	Sequence
Graphics mode	10	Stx, address, 10, data—data, Etx, Etx
External E^2 memory mode	11	Stx, address, 11, data—data, Etx, Etx
Set writing address to display	12	Stx, address, 12, adress0-7, address8-15, adress16, Etx, Etx
Set writing address to E^2 memory	13	Stx, address, 13, adress0-7, address8-15, adress16-24, Etx, Etx
Transfer block from E^2 mem to display	14	Stx, address, 14, width0-7, width8-15, height0-7, height8-15, Etx, Etx
Read internal 1375 registers	15	Stx, address, 15, address, address, ----, Etx, Etx
Write 1375 set-up data to internal E^2 memory	16	Stx, address, 16, address, data—data, Etx, Etx
Initialise 1375 registers	17	Stx, address, 17, Etx, Etx
Character mode	18	Stx, address, 18, data—data, Etx, Etx
Set writing position	19	Stx, address, 19, x-data, y-data, Etx, Etx
Set character attribute	1A	Stx, address, 1A, size-data, foreground-colour-data, background-colour-data, Etx, Etx
Clear all display memory	1B	Stx, address, 1B, Etx, Etx
Transfer compressed block from E^2 mem to display	1C	Stx, address, 1C, width0-7, width8-15, height0-7, height8-15, Etx, Etx

Protocol description

Data is sent to the VBWV1 board in packets framed with Stx (02h) and Etx Etx (03h 03h). The Byte following the Stx character is the board address 00 to FFh, this enables several boards to be on one bus. Sending address 00 will access all boards regardless of their address value. The Byte following the address defines the command. To prevent false end of packet sequences occurring in the data being sent, the following action should be taken: If Etx (03h) occurs in the data, the transmitter should send a Null (00h) character after it, the receiver then detects this 03h 00h sequence, removes the 00h and writes 03h as data. This ensures genuine end of packet sequences and general data are distinguishable.
After the end of packet sequence Etx Etx, an Ack (06h) character is transmitted to confirm success. If an error occurred then a Nak (15h) character is transmitted.

Command Description

Graphics Mode 10h – After the 10h command any amount of data can be sent, which will be stored in display memory starting at the address set by command 12h. The address is auto-incremented after each write.

External E^2 Memory Mode 11h – After the 11h command any amount of data can be sent, which will be stored in external E^2 memory, starting at the address set by command 13h. The address is auto-incremented after each write. Also after each write, a DC4 (14h) character is transmitted to confirm success, or Nak (15h) for failure.

Set writing address to Display 12h – The three bytes following the 12h command define the display memory writing address, in the order Address0-7, Address8-15, Address16. Note : only the first bit in byte three is used as the address range is A0 to A16.

Set writing address to E^2 memory 13h – The three bytes following the 13h command define the E^2 memory writing address, in the order Address0-7, Address8-15, Address 16-24. Note : Address16-24 is included for future increases in memory size.

Transfer block from E^2 memory to Display memory 14h – The four bytes following the 14h command define the width and height of the block to be transferred as follows : The first two bytes width0-7 and width8-15 define the block width in bytes –1, i.e. At 4bpp, a width value of 23 will give a pixel width of 48. The second two bytes height0-7 and height8-15 define the block height in pixels – 1, i.e. a height value of 47 will give a height of 48 pixels.
Before executing this command, the set writing address commands 12h and 13h should be set. After completion, a DC4 (14h) character is transmitted to confirm success, or Nak (15h) for failure.

Read internal E^2 memory 15h – The command 15h enables data to be read from the Microcontroller internal E^2 memory. Address bytes following the command are replied to with the data at that address. Etx, Etx ends the command.

Initialise controller registers 17h – The command 17h initialise the controller registers and look up table, from the Microcontroller internal E^2 memory. A DC4 (14h) character is transmitted to confirm success, or Nak (15h) for failure.

Continued……

Continued……

Character mode 18h – After this command 18h data is accepted as ASCII character data, and characters are written to the display. Back space 08h, Carriage return 0Dh, and Line feed 0Ah are also interpreted. After each character a DC4 (14h) character is transmitted to confirmed success, or Nak (15h) for failure. The character set is stored in the Microcontroller flash memory and can be easily modified. Please contact supplier for more details.

Set character writing position 19h – The two bytes following the 19h command define the X and Y positions, in characters (8x8), where the next character will be written. (0,0 = top left)

Set character attributes 1Ah – The three bytes following the 1Ah command define the character attributes as follows : Character size0 for 8x8 and 1 for 8x16. Foreground colour byte. Background colour byte. Default is 00h, 0Fh, 00h.

Clear all display memory 1Bh – All display memory is filled with 00h. A DC4 (14h) character is transmitted to confirm success, or Nak (15h) for failure

Transfer compressed block from E^2 memory to Display memory 1Ch – This command operates the same as command 14h, except the transfer routine assumes compressed image data (8 bit RLE is used). For certain types of image where there are large blocks of the same colour, compression improves both speed and memory space used.

Write controller set-up data to internal E^2 memory 16h – The command 16h enables data to be written to the Microcontroller internal E^2 memory. This memory holds display register, colour look up table, and interface set-up information. This is used to configure the board on power-up or after command 17h. The first byte after the command defines the address, which is then followed by data. The address auto-increments after each write and a DC4 (14h) character is transmitted after each byte to confirm success.

The **table on page 6-8** defines the correspondence between the internal E^2 memory and display controller registers

If the address 48h has any value other than FFh, then a transfer compressed block command is carried out on power-up using the width and height values in the internal E^2 memory from 48h to 4Bh.

Address 4Ch and 4Dh contain the PIC software checksum for identification purposes.

Address 4Eh contains the serial baud rate set at power-up, 0=normal (LC chips), 1=fast (FC chips)

Address 50h contains the board address. The board will respond to commands when the address sent corresponds to the value stored at this location or the address is set to 00h. Avoid using address 03h as it can conflict with the end of packet character.

Note : For displays requiring 8bpp (256 colour) the remainder of the look up table will need to be loaded via the serial interface, directly into the display controller.

Continued……

Internal E^2 memory address	Display controller register value	Example for 320x240 colour STN at 4bpp (16 clrs)	Register Description
00h	01h	27h	Mode register 0
01h	02h	80h	Mode register 1
02h	03h	03h	Mode register 2
03h	04h	27h	Horizontal panel size register
04h	05h	Etf	Vertical panel size (LSB) –1
05h	06h	00h	Vertical panel size (MSB)
06h	07h	00h	Fpline start position
07h	08h	00h	Horizontal non-display period
08h	09h	00h	Fpframe start position
09h	0Ah	05h	Vertical non-display period
0Ah	0Bh	00h	Mod rate register
0Bh	0Ch	00h	Screen1 start address register (LSB)
0Ch	0Dh	00h	Screen1 start address register (MSB)
0Dh	0Eh	00h	Screen 2 start address register (LSB)
0Eh	0Fh	00h	Screen2 start address register (MSB)
0Fh	10h	00h	Screen1 start address register overflow (A16)
10h	11h	00h	Memory address offset register
11h	12h	FFh	Screen1 vertical size register (LSB)
12h	13h	03h	Screen1 vertical size register (MSB)
13h	18h	00h	GPIO configuration control register
14h	19h	00h	GPIO status/control register
15h	1Ah	00h	Scratch pad register
16h	1Bh	00h	Swivel view mode register
17h	1Ch	00h	Swivel view line byte count register
18h,19h,1Ah	17h	00h,00h,00h	Look up table RGB index value 00 (black)
1Bh,1Ch,1Dh	17h	80h,00h,00h	Look up table RGB index value 01 (dark red)
1Eh,1Fh,20h	17h	00h,80h,00h	Look up table RGB index value 02 (dark green)
21h,22h,23h	17h	80h,80h,00h	Look up table RGB index value 03 (dark yellow)
24h,25h,26h	17h	00h,00h,80h	Look up table RGB index value 04 (dark blue)
27h,28h,29h	17h	80h,00h,80h	Look up table RGB index value 05 (dark magenta)
2Ah,2Bh,2Ch	17h	00h,80h,80h	Look up table RGB index value 06 (dark cyan)
2Dh,2Eh,2Fh	17h	B0h,B0h,B0h	Look up table RGB index value 07 (light grey)
30h,31h,32h	17h	70h,70h,70h	Look up table RGB index value 08 (dark grey)
33h,34h,35h	17h	F0h,00h,00h	Look up table RGB index value 09 (light red)
36h,37h,38h	17h	00h,F0h,00h	Look up table RGB index value 10 (light green)
39h,3Ah,3Bh	17h	F0h,F0h,00h	Look up table RGB index value 11 (light yellow)
3Ch,3Dh,3Eh	17h	00h,00h,F0h	Look up table RGB index value 12 (light blue)
3Fh,40h,41h	17h	F0h,00h,F0h	Look up table RGB index value 13 (light magenta)
42h,43h,44h	17h	00h,00h,F0h	Look up table RGB index value 14 (light cyan)
45h,46h,47h	17h	F0h,F0h,F0h	Look up table RGB index value 15 (white)
48h	N.a	9Fh	Display block on power up width0-7
49h	N.a	00h	Display block on power up width8-15
4Ah	N.a	Efh	Display block on power up height0-7
4Bh	N.a	00h	Display block on power up height8-15
4Ch	N.a	1Fh	Software identification low byte (checksum used)
4Dh	N.a	8Ch	Software identification high byte (checksum used)
4Eh	N.a	04H	Serial baud rate 0=9600, 1=19200, 2=38400, 3=57600, 4=115200
4Fh	N.a	01h	I2C rate 0=normal (LC chips) 1=fast (FC chips)
50h	N.a	00h	Board Address. 00 to FFH. AVOID address 03h

RS232 / RS485 Interface

Format:

Baud rate	19200 (default)
Data	8 bits
Parity	None
Stop bits	1

The RS485 interface is available as an option in place of the RS232 interface. Contact your supplier for more details

I^2C Interface

The I^2Cbus is connected to the on board E^2 memory IC's 7-10 (address 00 to 03) and the Microcontroller.
This enables direct access to the E^2 memory if required and fast access to the Microcontroller.

Electrical Specification

Symbol	Parameter	Min	Typ	Max	Unit
VCC in	Logic supply voltage	4.5	5	5.5	V
+12V in	Back light inverter supply	0	12	15	V
VDD safe out	Switched +5V out	VCC	VCC	VCC	V
IDD safe out				1	A
VEE +/-	LCD bias voltage	-30		+42	V
IEE +/-				30	mA
VEECON	LCD control voltage adjusted via VR1. LK2 made	1		34	V
VEECON	(+12V in must be present) LK3 made	1		41	V
VEECON	LH4 made	1		29	V
VEECON	LK5 made	-29		-1	V
+12V safe out	Switched +12V out to backlight inverter	0 in	+12 in	+15 in	V
+12I safe out				1	V
Top	Operating temperature	0		+70	^{O}C
Tstg	Storage temperature	-40		+125	^{O}C

Further information

Please refer to the Epson S1D13705 Specification for further details of the features available.

Character set

As the character set is stored in the Microcontroller flash memory it is easily modified for custom characters.